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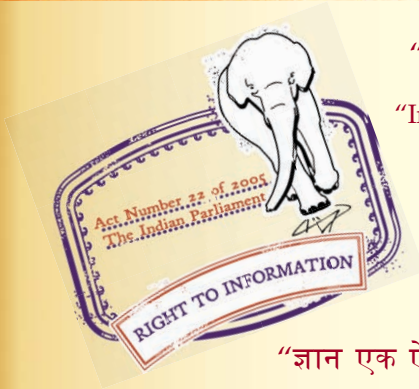
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IS 6181 (1971): Varnish Bonded Glass-Fibre Braided Rectangular Copper Conductors [ETD 33: Winding Wire]



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“Knowledge is such a treasure which cannot be stolen”

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IS : 6181 - 1971

Indian Standard
SPECIFICATION FOR
VARNISH BONDED GLASS-FIBRE BRAIDED
RECTANGULAR COPPER CONDUCTORS

(First Reprint APRIL 1985)

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard

SPECIFICATION FOR VARNISH BONDED GLASS-FIBRE BRAIDED RECTANGULAR COPPER CONDUCTORS

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Indian Standard

SPECIFICATION FOR VARNISH BONDED GLASS-FIBRE BRAIDED RECTANGULAR COPPER CONDUCTORS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 19 July 1971, after the draft finalized by the Winding Wires Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 Varnish-bonded glass fibre-braided conductors could be used for various applications, depending on the type of varnish used as bonding material. The complete conductor would be classified depending on the varnish, for thermal stability in service as detailed in IS : 1271-1958*.

0.3 It is necessary that the impregnating varnish should be compatible with the bonding material. In the absence of a functional test to evaluate the compatibility, the question of compatibility shall be kept in mind by the user. However, a test to evaluate the compatibility is under consideration.

0.4 In preparing this standard assistance has been derived from:

Doc : 55 (Secretariat) 76 Methods of test for winding wires. Part...
Fibrous covered rectangular conductors. International Electro-
technical Commission.

Doc : 55 (Secretariat) 84 Specifications for particular types of wires.
Part...Specification sheet for varnish-bonded glass braided
rectangular copper wires. International Electrotechnical
Commission.

Document 70/3817 Draft British Standard Specification for varnish
bonded glass braided copper conductors Part II : Rectangular
conductors (metric units). British Standards Institution.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Classification of insulating materials for electrical machinery and apparatus in relation to their thermal stability in service.

†Rules for rounding off numerical values (revised).

1. SCOPE

1.1 General — This standard relates to varnish bonded glass fibre covered rectangular copper conductors, the glass covering being a single braid of glass fibre, bonded with a suitable highly polymerized thermo-setting varnish of temperature index at least 130°C.

NOTE — The individual temperature ratings for the different types of varnishes may be agreed upon between the manufacturer and the user.

1.1.1 It does not apply to stranded or laminated conductors or to conductors covered with a layer of material other than the bonded glass braid.

1.2 Sizes — The requirements of this standard are applicable to conductors having thicknesses from 0.80 up to and including 5.6 mm and widths from 2 up to and including 16 mm. A schedule of preferred sizes is given in IS: 6160-1971*.

1.3 Grades of Covering — Three grades of covering are specified:

- a) Fine (F),
- b) Medium (M), and
- c) Thick (T).

NOTE — *Edgewise Bending* — Covered conductors conforming to this Indian Standard are not necessarily suitable for severe edgewise bending. Any special test requirements should be agreed between the purchaser and the supplier.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Wire — The insulated material as received.

2.2 Conductor — The bare metal after removal of the glass covering.

2.3 Increase in Dimensions due to Covering — The difference between the width or thickness over the glass covering and the corresponding dimension of the conductor.

2.4 Tolerance — The permissible divergence of an actual magnitude from that prescribed.

3. GENERAL TEST CONDITIONS

3.1 Unless otherwise specified, all tests shall be carried out within a temperature range of 10 to 40°C and at a relative humidity not greater than 85 percent. Before measurements are made, the specimens shall be

*Specification for rectangular conductors for electrical machines.

AMENDMENT NO. 1 AUGUST 1974
TO
IS : 6181-1971 SPECIFICATION FOR VARNISH
BONDED GLASS-FIBRE BRAIDED
RECTANGULAR COPPER
CONDUCTORS

Alterations

(Page 4, clause 3.1)

- a) *Line 2* — Substitute '15 to 35°C' for '10 to 40°C'.
- b) *Lines 2 and 3* — Substitute 'relative humidity range of 45 to 75 percent' for 'relative humidity not greater than 85 percent'.

(ETDC 33)

preconditioned under these atmospheric conditions for a time sufficient to allow specimens to reach stability.

3.2 The wire to be tested shall be removed from the packaging in such a way that the wire will not be subjected to tension or unnecessary bends.

3.3 Before each test sufficient wire shall be discarded to ensure that any damaged wire is not included in the test specimens.

3.4 When no specific range of sizes is given for a test, the test is applicable to all sizes.

4. CONDUCTOR

4.1 The conductor shall fully conform to **3.1** of IS : 6160-1971*.

5. GLASS COVERING

5.1 General — The conductor shall be covered with a single braid of glass fibre.

5.2 Glass Fibre Yarns

5.2.1 The yarns shall be continuous filament glass fibre containing not more than 1 percent of alkali calculated as sodium oxide (Na_2O)†.

5.2.2 When required by the purchaser, the supplier shall state the conductivity and pH value of aqueous extract of the glass fibre used for the covering when tested in accordance with **9** and **10** of IS : 5596-1970‡.

5.3 Application of Glass Braid — The glass braid shall be applied firmly, evenly and closely, and shall be firmly bonded to the conductor with a suitable varnish. The type and thermal rating of the varnish shall, where necessary, be agreed between the supplier and the purchaser.

5.4 Increase in Dimensions due to Covering — The dimensions of the bare and covered conductor shall be determined by the method described in Appendix A.

5.4.1 The increase in dimensions due to the covering shall be not less than the appropriate value given in col 2 of Table 1, and the overall dimensions shall not exceed the maximum permitted for the bare conductor plus the appropriate value given in col 3 of Table 1.

*Specification for rectangular conductors for electrical machines.

†Usually known as 'E Glass'.

‡Method of test for determining deleterious substances in fibrous insulating materials.

TABLE 1 INCREASE IN DIMENSIONS DUE TO THE COVERING

(Clause 5.4.1)

GRADE OF COVERING	MINIMUM INCREASE IN DIMENSION OVER ACTUAL CONDUCTOR DIMENSION	MAXIMUM INCREASE IN DIMENSION OVER MAXIMUM PERMISSIBLE CONDUCTOR DIMENSION
(1)	(2)	(3)
	mm	mm
Fine (F)	0.35	0.43
Medium (M)	0.45	0.53
Thick (T)	0.55	0.63

5.5 Flexibility and Adherence**5.5.1 Flexibility**

5.5.1.1 As received — Samples of the glass-braided conductor shall be bent through 180° round a mandrel having a diameter 10 times the bare width of the conductor when it is bent on edge, or 10 times the bare thickness when it is on the flat. Separate samples shall be bent, two on edge and two on the flat and when so tested the covering shall not open sufficiently to expose the bare conductor to view, when examined under diffused light by normal eyesight. There shall be no appreciable loosening of the insulation.

5.5.1.2 After heating — Samples which have been heated for 16 hours in an oven at a temperature of 150°C and then allowed to cool to room temperature, shall pass the test for flexibility specified in 5.5.1.1 above.

5.5.2 Adherence

5.5.2.1 A sample approximately 300 mm long shall be straightened, for example, by elongating 1 percent. The covering shall be removed from all but from the central 100 mm of the wire. The specimen shall be elongated in an elongation tester or a tensile testing machine. The free measuring length shall be between 200 and 250 mm. The sample shall be elongated at a rate between 1 and 5 mm/s.

The covering shall not lose adhesion after an elongation for the appropriate width : thickness ratio as given below. Loss of adhesion of covering is shown by its being able to slide along the conductor as a whole or being detached in part:

Width : Thickness Ratio		Elongation, percent
Up to and including	2 : 1	5
Over	2 : 1	10

These elongations shall be halved in the case of *silicone bonding varnish*.

5.6 Breakdown Voltage — The wire shall meet the requirements of 5.6.1 and 5.6.2 when tested at room temperature and at elevated temperature respectively.

5.6.1 Test at Room Temperature — Samples shall be subjected to a breakdown voltage test by the method described in Appendix B. At least four of the five places tested shall not breakdown at voltages less than those given in Table 2.

5.6.2 Test at Elevated Temperature — When tested by the method described in Appendix B at the rated temperature, at least four of the five places tested shall not breakdown at voltages less than those given in Table 2.

TABLE 2 BREAKDOWN VOLTAGES

(Clauses 5.6.1 and 5.6.2)

GRADE OF COVERING	BREAKDOWN VOLTAGE, Min	
	At Room Temperature V (rms)	At Elevated Temperature V (rms)
(1)	(2)	(3)
Fine (F)	630	470
Medium (M)	810	610
Thick (T)	990	740

5.7 Cure Test

5.7.1 Two wires 200 mm long shall be laid flat to flat and bound tightly with polyester fibre tape. The specimen shall then be placed in a hot, air circulating oven, at 120°C, and left for 30 minutes. It shall then be removed and after removing the binding tape it shall be possible to separate the wires without damaging the covering.

NOTE — This test may be omitted on special coverings, if agreed between the supplier and the purchaser.

6. PACKING AND MARKING

6.1 The covered conductor shall be wound on drums, packed, wrapped and labelled in accordance with IS : 2069-1962*.

*Specification for drums for covered winding wires and strips for electrical purposes.

IS : 6181 - 1971

6.1.1 The label which is to be securely attached to drum shall have the following information:

- a) Manufacturer's name or trade-mark,
- b) Grade of covering,
- c) Conductor dimensions, and
- d) Weight of wire.

6.2 The label may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act, and the Rules and Regulations made thereunder. Presence of this mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard, under a well-defined system of inspection, testing and quality control during production. This system, which is devised and supervised by ISI and operated by the producer, has the further safeguard that the products as actually marketed are continuously checked by ISI for conformity to the standard. Details of conditions, under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

A P P E N D I X A

(Clause 5.4)

MEASUREMENT OF DIMENSIONS

A-1. MEASURING EQUIPMENT

A-1.1 The measurement shall be made with an accuracy better than 0.002 mm. If a micrometer is used, it shall be ensured that the measuring force is in the range of 0.75 to 3.0 N. The spindle and the anvil of the micrometer shall have a diameter of 5 to 8 mm.

A-2. MEASURING METHODS

A-2.1 Overall Dimensions — Measurements shall be made of both dimensions of the covered conductor at three positions not less than 100 mm apart. The measurements shall be made on completely straight parts of the wire.

Where the dimension of the covered conductor is greater than the diameter of the micrometer spindle, measurements shall be made both at the centre of the face of the wire and over the edges. If the values differ, the highest value only shall be noted.

The average of the three results for each dimension shall be reported as the ' overall width ' and ' overall thickness '.

A-2.2 Conductor Dimensions — The covering shall be removed by any method which does not damage the conductor for the three positions used for measurements in A-2.1 and the conductor dimensions measured at these positions.

The average of the results shall be reported as 'conductor width' and 'conductor thickness'.

A-2.3 Increase in Dimensions due to Covering — The difference between the overall width and the conductor width shall be reported as the 'increase in width'.

The difference between the overall thickness and conductor thickness shall be reported as 'increase in thickness'.

APPENDIX B

(Clauses 5.6.1 and 5.6.2)

BREAKDOWN VOLTAGE

B-1. TEST VOLTAGE

B-1.1 The test voltage shall be alternating and of a nominal frequency of 50 Hz and approximately sinusoidal, the peak factor being within the limits of $\sqrt{2} \pm 5$ percent (1.34 to 1.48). The test transformer should have a rating of at least 500 VA and should provide a current of essentially undisturbed wave form under test conditions.

B-1.2 The voltage is applied at zero and increased at a uniform rate of approximately 100 V/s until breakdown occurs. In the event of breakdown occurring in less than 5s, the rate of increase is reduced to ensure that breakdown does not occur in less than 5s.

B-2. TEST AT ROOM TEMPERATURE

B-2.1 Five electrodes are prepared by applying a strip of thin metal foil having a width of 6.0 mm to the centre of a pressure sensitive tape 12.0 mm wide. The tape should not extend beyond the ends of the metal foil.

B-2.2 A sample of wire is used of such length that the five electrodes can be applied at intervals of approximately 50 mm. The electrodes are applied in the wire with the tape at right angles to the wire and the foil in contact with the wire. The tape is wrapped smoothly and firmly round the wire.

B-2.3 The glass covering is removed from one end of the sample and a voltage is applied between the conductor and each electrode in turn, thus giving five tests on the sample of wire.

B-3. TEST AT ELEVATED TEMPERATURE

B-3.1 The electric strength test at elevated temperature (which shall be the rated temperature) is carried out exactly as the room temperature electric strength test, except that the prepared specimen is inserted into a heating chamber which raises the temperature of the specimen to the required test temperature.

B-3.2 The heating chamber is designed to allow application of the break-down voltage without disturbance to the temperature of the specimen. The temperature of the chamber is maintained within $\pm 5^{\circ}\text{C}$ of the specified temperature.

B-3.3 The specimens are inserted in the hot chamber and allowed to remain until they reach the specified temperature. The test should be made within 15 minutes after attaining the temperature and the total time in the chamber should not exceed 30 minutes.

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